PROCEDURE FOR FABRICATING FIRING DEVICE AND WOODEN BOX MINE

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I. INTRODUCTION

The purpose of this manual is to provide detailed information and a step-by-step procedure for the fabrication of all parts, and assembly of an improvised box mine. All the parts for the firing device can be manufactured from standard brass stock in a small machine shop by machinists without special skills. The steel ball is a standard ball bearing and the steel spring is formed from music wire. A carpenter can make the boxes of soft wood (white pine, preferably) with a minimum of tools.

The methods described in this manual are not the only ones possible; however, they do lend themselves to the production of considerable quantities of the item. A turret lathe will speed manufacture of the parts for the firing device, for example, but a conventional lathe will serve the purpose very well.

The step-by-step procedures described in detail throughout the manual are intended to provide all instructions necessary for a person unskilled in the operation of the various machines and tools described; a skilled machinist and carpenter will need only the drawings which are furnished. The assembled firing device is shown in Drawing No. 1. Details of the assembly will be described throughout the manual.

The function of the firing device is to release a firing pin and allow it to strike a primer which in turn fires a blasting cap to initiate the explosive charge contained in the wooden box. When the firing device is assembled as shown (Drawing No. 1), pressure against the end of the firing device will compress the firing pin spring and force the sleeve to slide over the body of the device until the steel ball is forced out into a hole drilled into the sleeve, thus releasing the firing pin. The compressed spring drives the firing pin downward to strike the cartridge primer.

The wooden box (Drawing No. 2) contains the explosive and also serves to hold the firing device in position. The box lid is grooved to weaken it so that the desired amount of pressure will compress the firing device and explode the mine. The breaking strengths of various types of wood differ considerably and, if wood other than white pine is used, it will be necessary to vary the slot depth to obtain the desired breaking pressure (10 psi).

II. BODY SECTION

The body section of the firing device is that portion on which other parts are assembled (see Drawing No. 1). It is manufactured from 16 mm (or larger) round brass bar stock.

Cutting Raw Material

A suitable length of bar stock is placed in a lathe and the protruding end turned off square. The material is machined to a diameter of 12.8 mm for a distance of 38.7 mm measured from the end (Fig. 1). (See Drawing No. 3). The portion on which threads are to be cut is machined to a diameter of 16 mm.

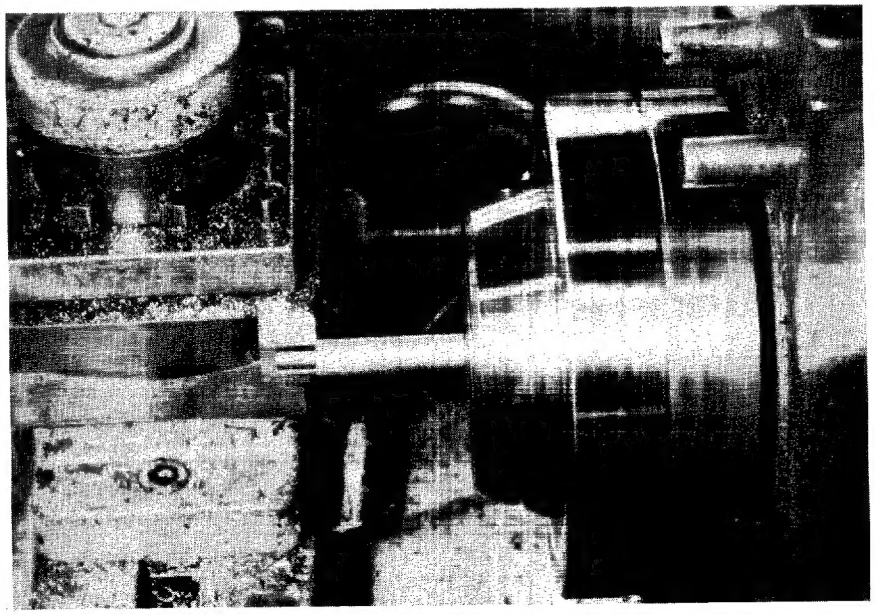

Fig. 1. Cutting Raw Material

Boring

Use a center drill (Fig. 2) to start boring out the center portion of the body section.

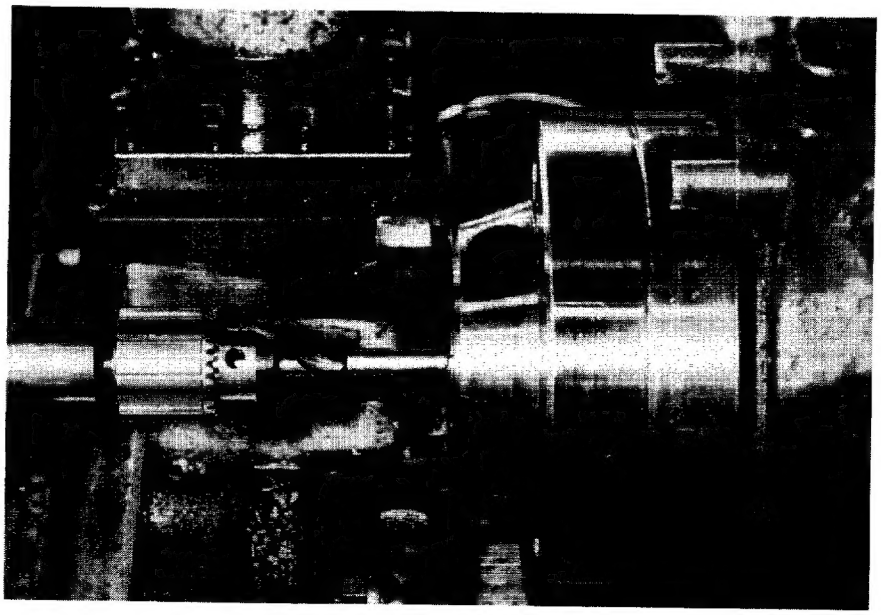

Fig. 2. Center Drilling Body Section

Drilling Finished Bore Hole in Body Section

Complete to final size by using a 9.4 mm straight shank drill (Fig. 3). The center drill will help align the larger drill for the finishing operation. The chamfer is made with a drill of larger diameter than the bore.

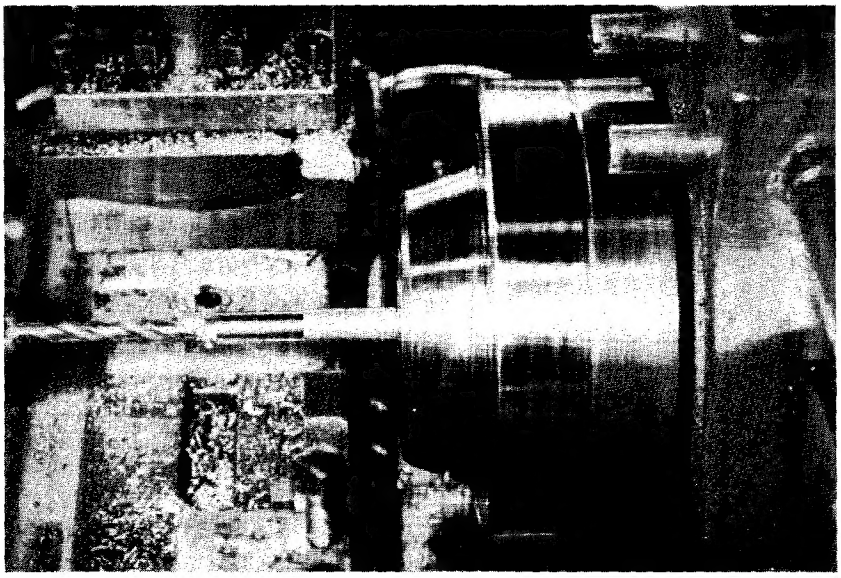

Fig. 3. Drilling Finished Hole in Body Section

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Cutting the Threads

The body section is threaded (see Drawing No. 3) before it is cut to length from the bar stock (Fig. 4). The threads must match those tapped in the cap as the two are screwed together when the device is assembled.

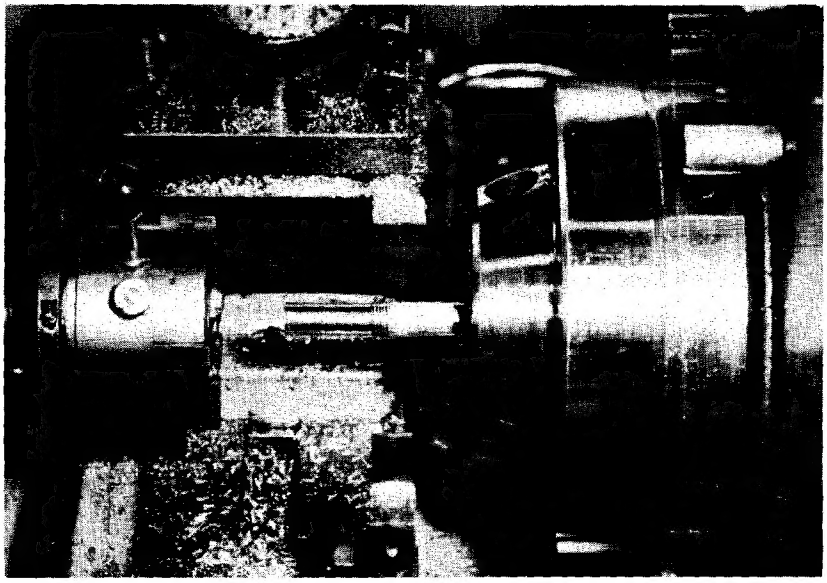

Fig. 4. Threads Are Cut on One End of the Body Section

Cutting to Length

The body section is now in the shape of a cylinder with threads cut on one end. Before further work can be done on the body, it must be cut to the required length (41.7 mm) leaving a thread length of 3 mm. The operation is performed with a parting tool (Fig. 5).

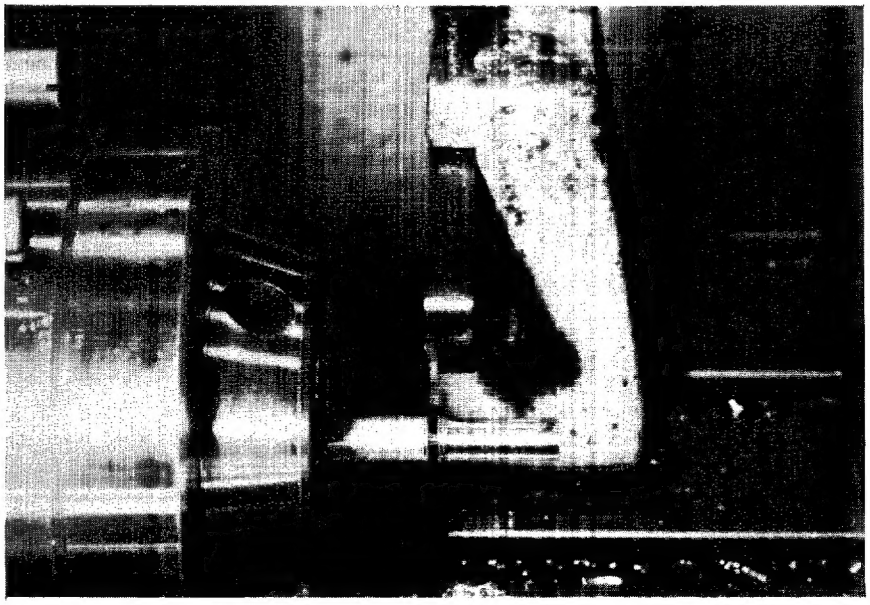

Fig. 5. Parting Off Body Section

Milling Retainer Pin Slot

Clamp the smooth portion of the body section in a vice and cut the retainer pin slot (see Drawing No. 3). Use a 2.4 mm end mill for the operation (Fig. 6).

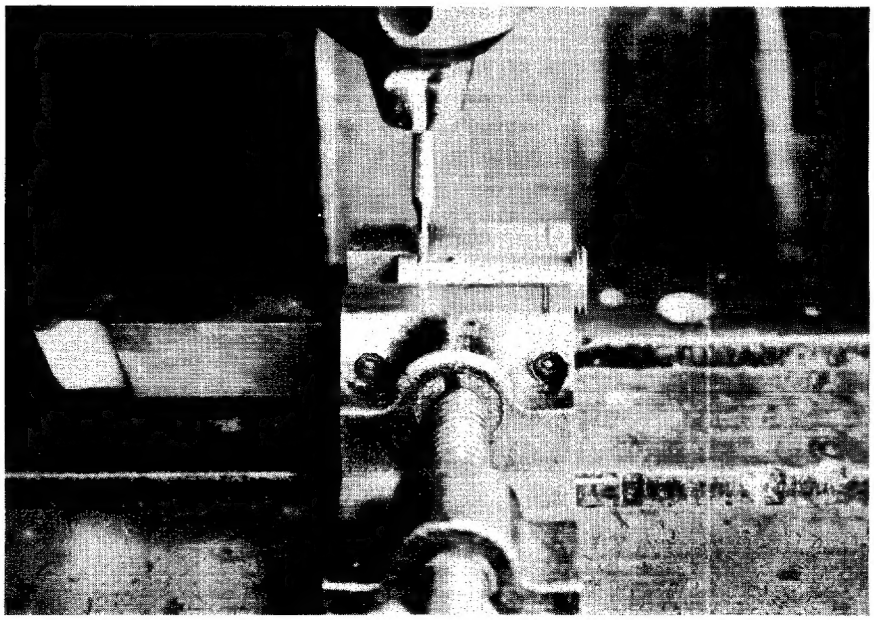

Fig. 6. Milling Retainer Pin Slot

Cutting Pressure Release Slots

Pressure release slots, which permit free movement of the firing pin, are cut in the threaded end of the body section. The operation is performed with a circular cutting wheel (Fig. 7). Only two cuts are necessary to obtain four slots when the saw is passed completely through both sides. The slots are 90° apart.

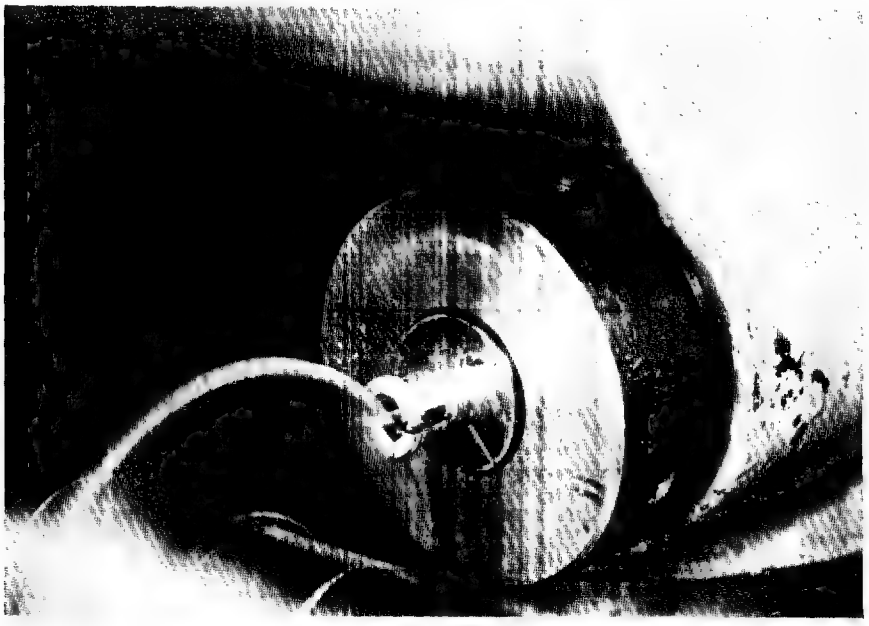

Fig. 7. Cutting Slots in Body Section

Drilling Ball Release Hole

The ball release hole is located on the side opposite the retaining pin slot and some difficulty may be experienced in properly positioning and holding the body section for the operation. A jig made of square stock will make it possible to rapidly and accurately perform the drilling operation and will be well worth the effort, especially if several of the firing devices are to be made. Fig. 8 shows the position of the hole in the jig through which a pin enters to line up the retaining pin slot to assure accurate orientation of the work.

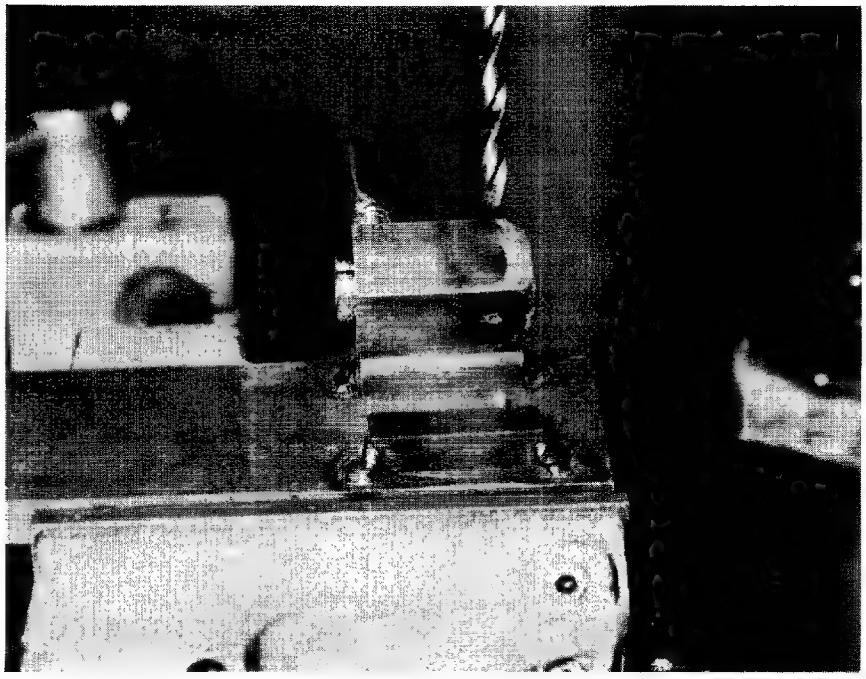

Fig. 8. Use of Jig For Holding Body Section

Use of Jig for Holding Body Section

Fig. 9 shows the hole in the jig through which the drill is inserted to drill the ball release hole. The wing screw is used to prevent movement of the body section during the drilling operation. See Drawing No. 3 for dimensions.

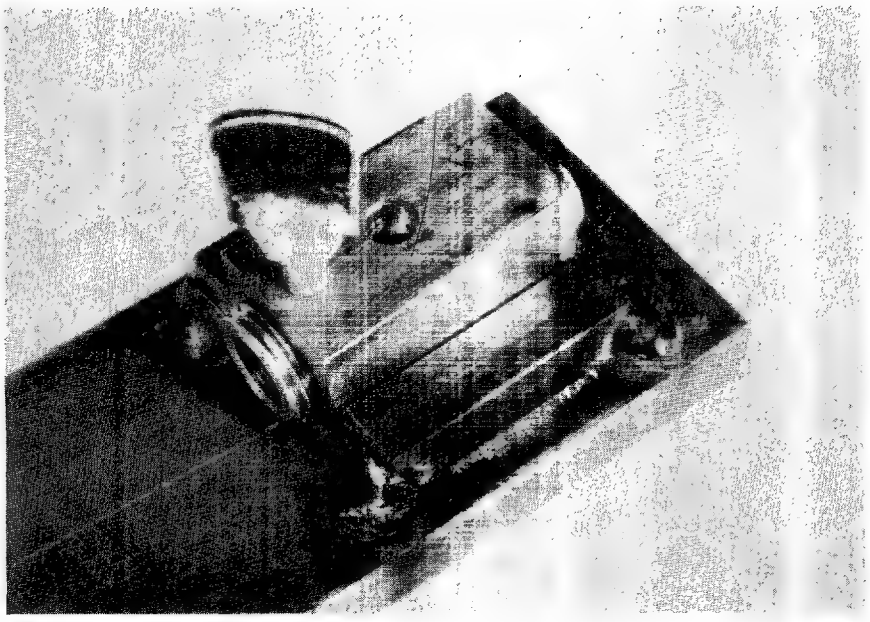

Fig. 9. Use of Jig for Holding Body Section

III. FABRICATING RETAINER PIN

The retainer pin can be made by using 2.0 mm or larger diameter round stock material. When parting off the pin to the desired length, a straight tool may be used which will form a flat head, this is permissible. (See Drawing No. 4).

IV. SLEEVE SECTION

The sleeve section of the firing device is that portion of the device that slides over the body section (see Drawing No. 1). It is held from rotating and limited in longitudinal movement over the body section by the retainer pin. When the sleeve section is in the extended position, the ball release holes in the body and sleeve do not coincide and the ball holds the firing pin from being forced forward by the firing pin spring. When pressure is applied to the firing device, the firing pin spring is compressed and the sleeve is forced to slide over the body section until the ball release holes coincide, permitting the ball to escape and releasing the firing pin. In order for the device to function peoperly, all parts must be accurately machined.

Turning and Boring Sleeve

The sleeve portion of the firing device is manufactured much the same manner as the body section described in Section II. Round brass stock is turned on a lathe to a diameter of 18 mm and a length of 44.5 mm. (See Drawing No. 5). Bore a 13 mm hole from one end of the piece to a depth of 38.5 mm. A sleeve, closed at one end and having a wall thickness of 2.5 mm, will be produced by this operation.

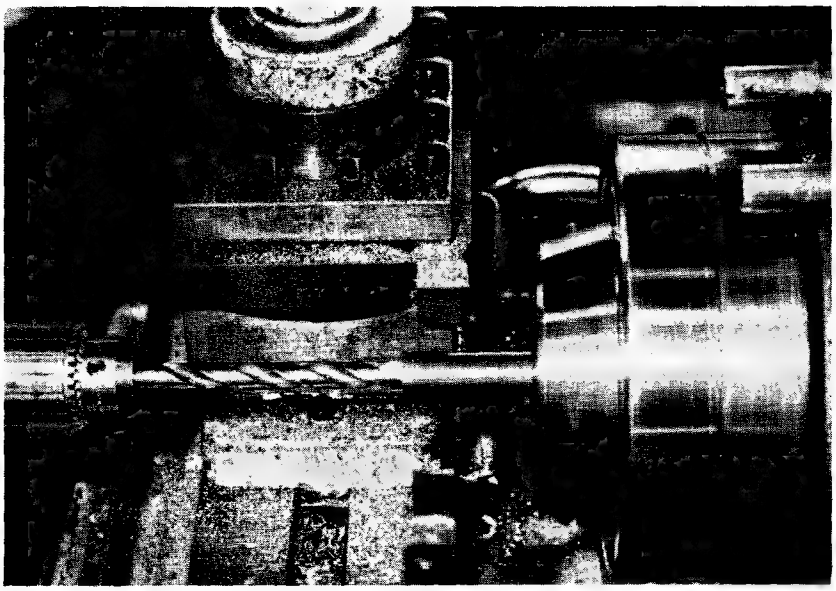

Fig. 10. Boring Sleeve Section

Cutting to Length

The sleeve is then cut off with a parting tool to a length of 44.5 mm.

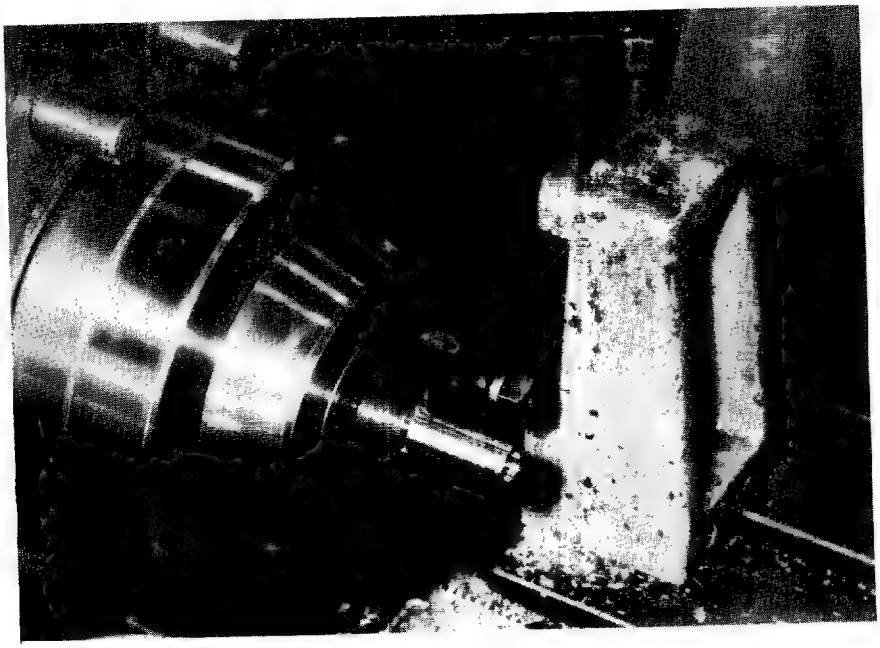

Fig. 11. Parting Off Sleeve Section

Drilling Holes in Sleeve

Drilling the ball release, vent, and retainer pin holes in the sleeve can be accomplished more accurately and rapidly with a jig (Fig. 12). Dimensions for making the jig can be obtained from Drawing No. 5.

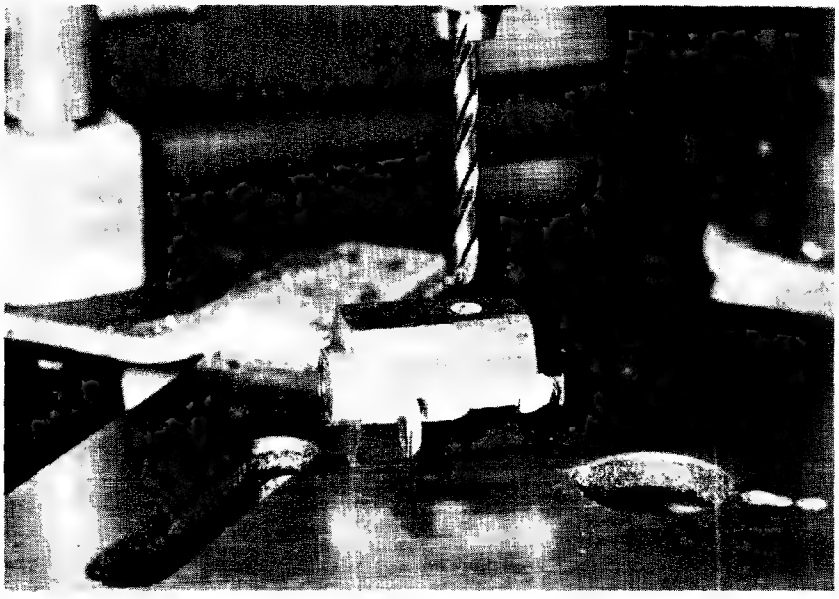

Fig. 12. Using Jig to Drill Ball Release Hole in Sleeve Section

V. CAP SECTION

The cap section of the firing device screws on the threaded end of the body (see Drawing No. 1). Its function is to provide a seat for the cartridge base and a nipple on which the blasting cap is crimped (see Drawing No. 6). The threaded connection to the body provides access to the inner parts of the firing device for loading and preparation for use.

Turning and Drilling

Brass round bar stock 18 mm in diameter is suitable material from which to make the cap section. If larger stock is used, turn it down to 18 mm for the required length. Drill a 3.2 mm hole to a depth of 25 mm into the center of the end of the bar (Fig. 13). The 3.2 mm hole is the finished size of the hole through the nipple part of the cap and will aid in guiding the larger drills when machining the threaded end of the cap section.

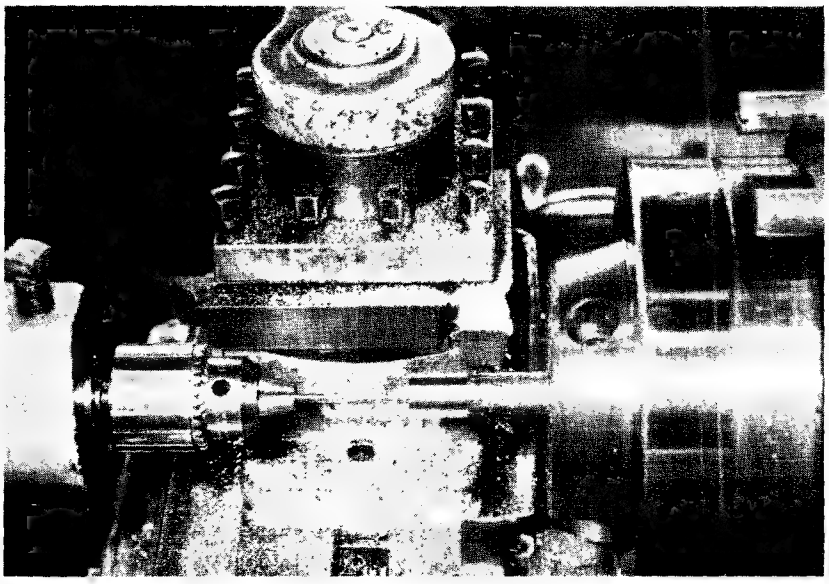

Fig. 13. Drilling Center Hole in Cap Section

Cartridge Chamber Forming

The cartridge chamber can be machined more accurately and in much less time by grinding a 12.5 mm drill as shown in Fig. 14. Dimensions can be obtained from Drawing No. 6. The drawing indicates square corners where the chamber diameters are reduced, but slightly rounded corners will not interfere with the functioning of the part.

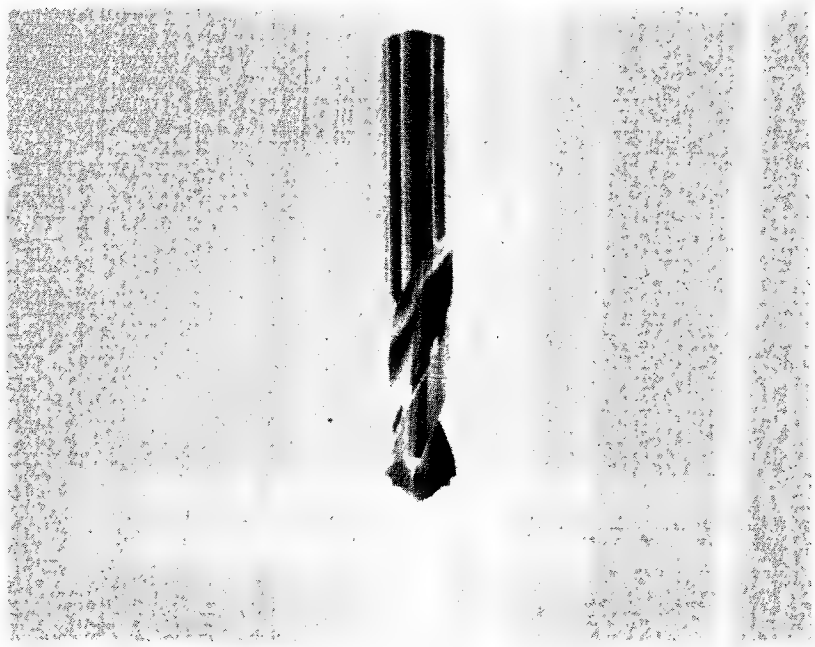

Fig. 14. Cartridge Chamber Forming Tool

Drilling Cartridge Chamber in Cap Section

Once the drill point is properly ground, forming of the cartridge chamber and drilling of the section to be threaded can be completed in one operation (Fig. 15).

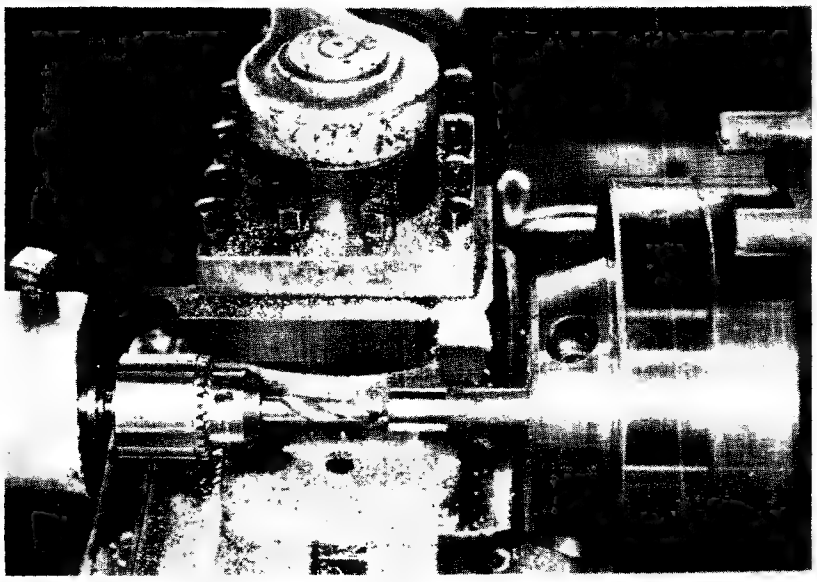

Fig. 15. Drilling Cartridge Chamber in Cap Section

Cutting Threads in Cap Section

In the preceding operation, the cap section was drilled in preparation for threading. The thread tapped into the cap must fit that machined on the body section and must extend to the cartridge chamber so the body will shoulder against any cartridge base placed in the device. Use a tapered tap of the required size (Fig. 16B) and finish the thread with a bottom tap (Fig. 16A).

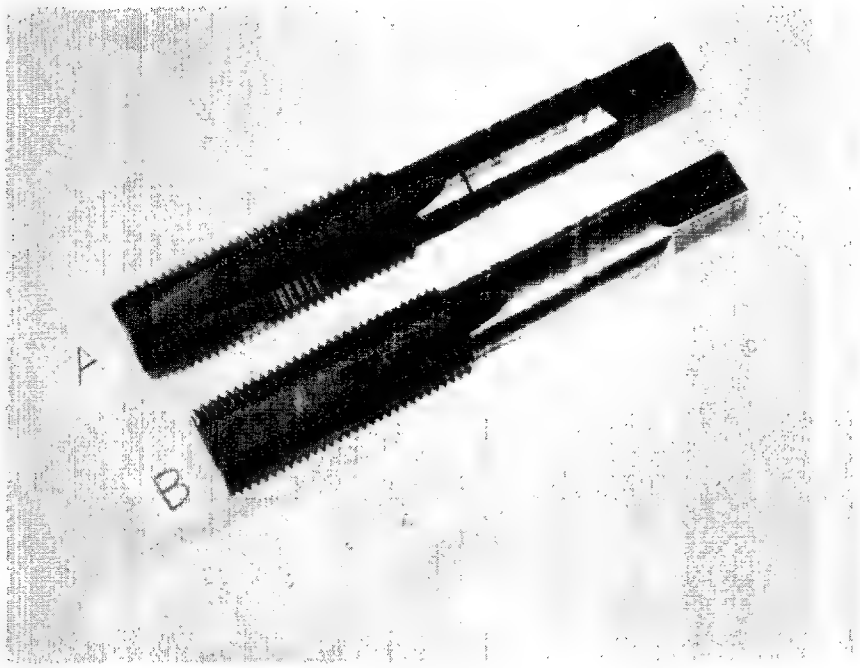

Fig. 16. Tapered Tap (A) and Bottom Tap (B)

Finishing Threads in Cap Section with Bottom Tap

The threading operation is performed while the material is still in the lathe (Fig. 17). The tapered tap is used first, then the bottom tap.

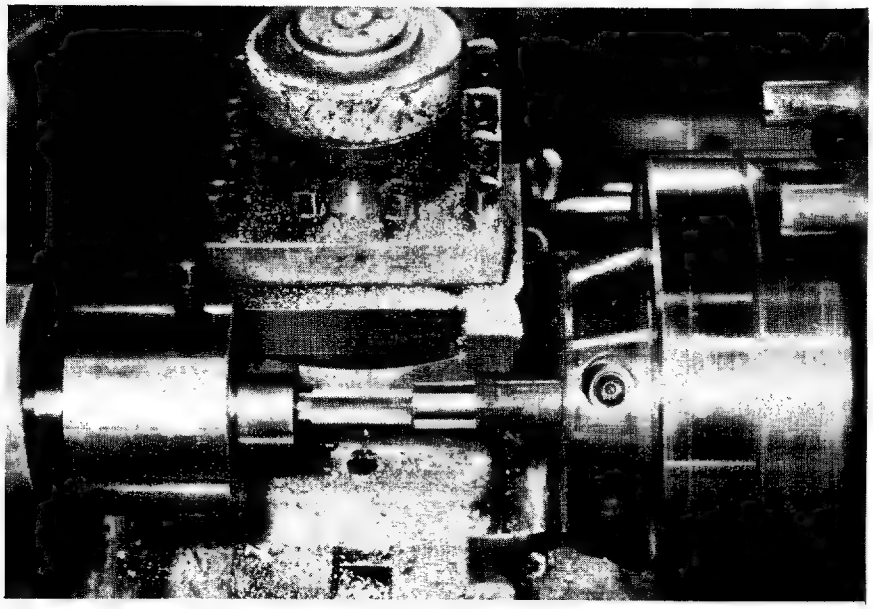

Fig. 17. Finishing Threads in Cap Section with Bottom Tap

Machining Nipple on Cap Section

The next step is to turn a nipple on the cap section. A blasting cap will be crimped on this nipple. The only critical dimensions are the two diameters of the nipple. If tool steel is ground to form a cutting tool as shown in Fig. 18, the operation will be somewhat simplified and considerable time saved. Dimensions for the nipple are on Drawing No. 6. A parting tool is used to cut the finished cap section from the stock.

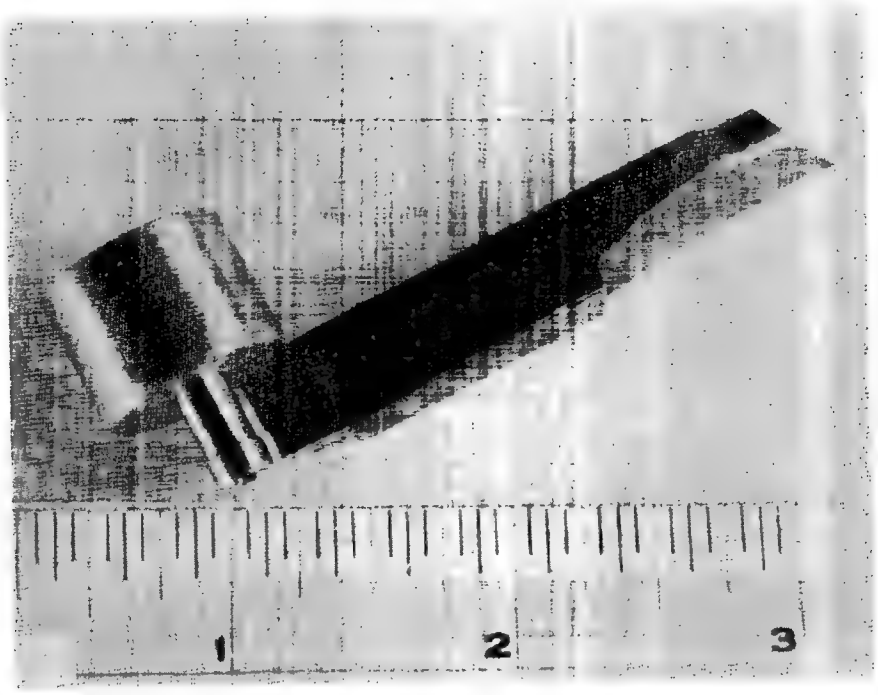

Fig. 18. Nipple Forming Tool for Cap Section

VI. FIRING PIN

The firing pin is positioned inside the body of the firing device and fits on one end of the firing pin spring. The pin is held in the cocked position by means of a steel ball which rests in the "V" shaped notch on the pin. (See Drawing No. 1 and 7). When the steel ball is allowed to be released the firing pin is pushed forward by the spring, thereby, striking the cartridge primer.

Firing Pin Point Forming Tool

Select a length of 10 mm, round, brass bar stock and turn down to 9 mm diameter for approximately 30 mm. To obtain uniform points on the firing pin, grind a tool (Fig. 19) according to dimensions in Drawing No. 7. Turn the point on the end of the stock.

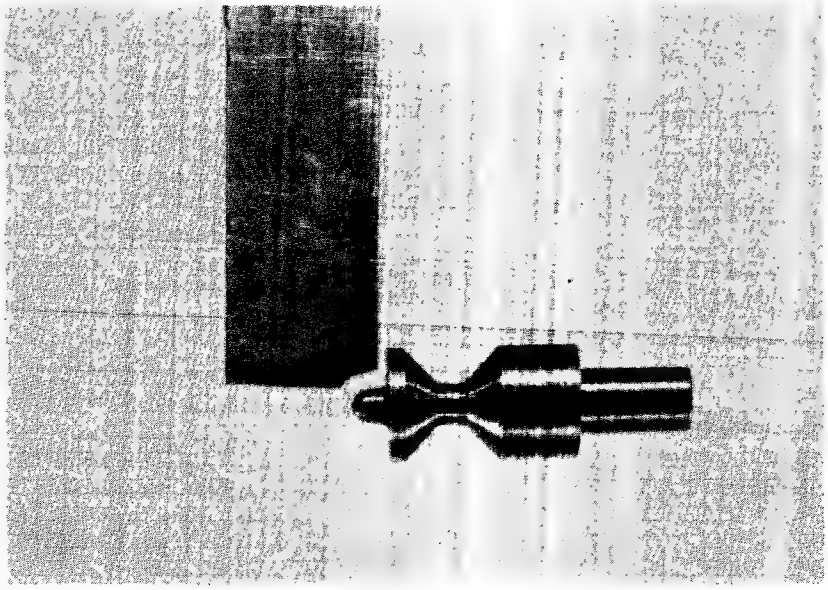

Fig. 19. Firing Pin Point Forming Tool

Ball Recess

The ball recess can be cut with tool steel ground in a truncated "V" shape. (Fig. 20).

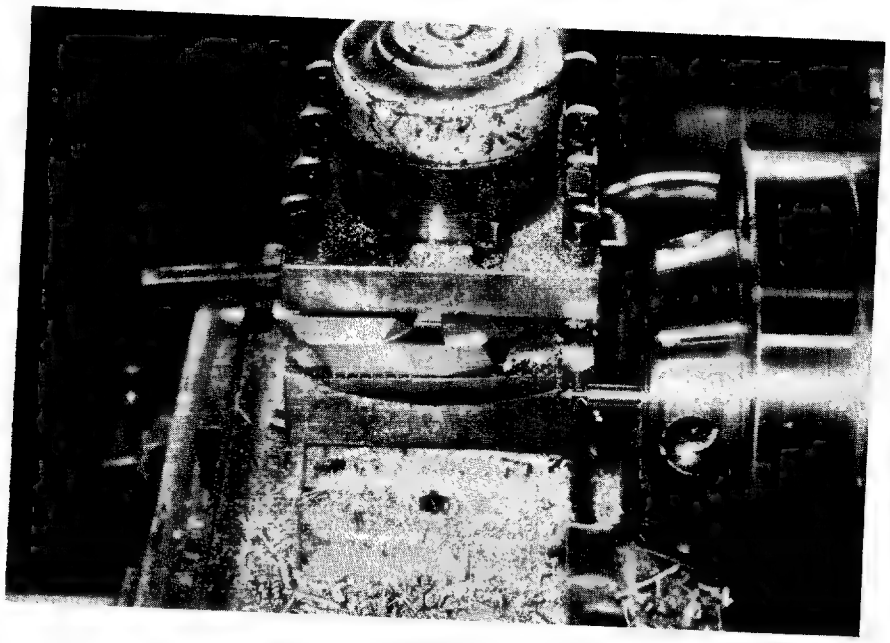

Fig. 20. Cutting Ball Recess on Firing Pin

Cutting Shank on Firing Pin

A shank to fit inside the firing pin spring is turned as shown in Fig. 21. All dimensions are shown in Drawing No. 7.

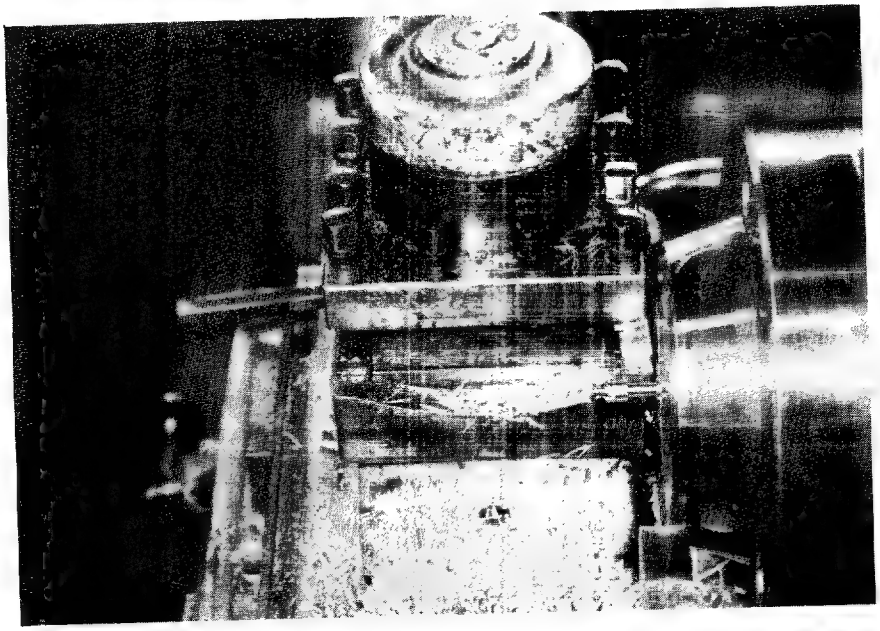

Fig. 21. Cutting Shank on Firing Pin

Firing Pin Spring

The firing pin spring positioned inside the body section and over the shank of the firing pin can be formed on a mandrel from spring steel or music wire of the required diameter (see Drawing No. 8). The mandrel on which the spring is wound (Fig. 22) must be somewhat smaller in diameter than the inside diameter of the finished spring as it will expand in diameter when the winding tension is released.

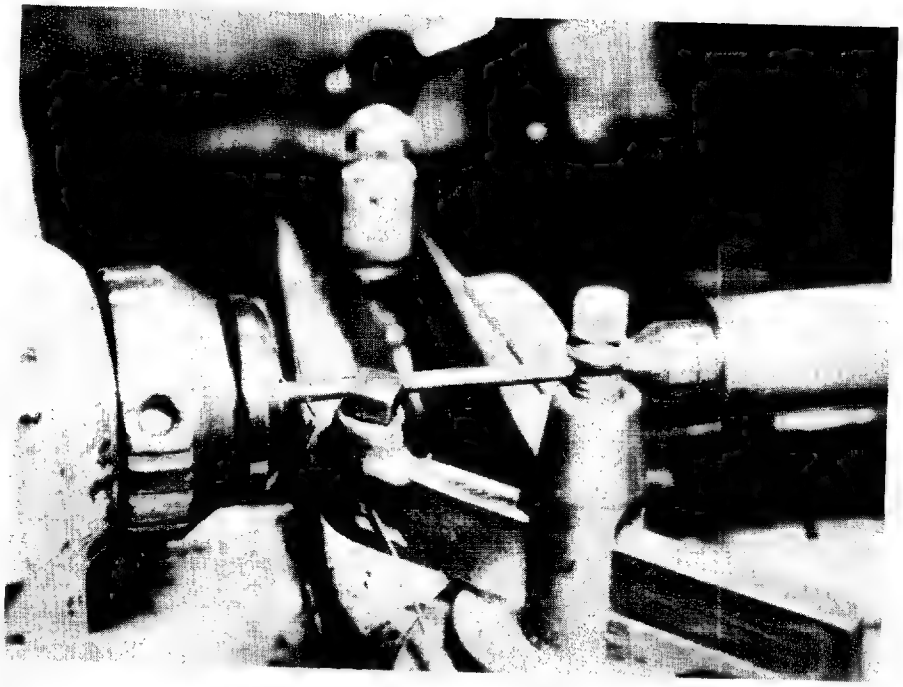

Fig. 22. Starting Firing Pin Spring on Mandrel

Winding the Spring

The spring is wound by turning the mandrel and holding considerable tension on the wire. A lead of four turns per centimeter (Fig. 23) while winding will result in a spring of desired shape. The spring must be wound to a length longer than required since a portion of each end must be cut off because of distortion caused by winding.

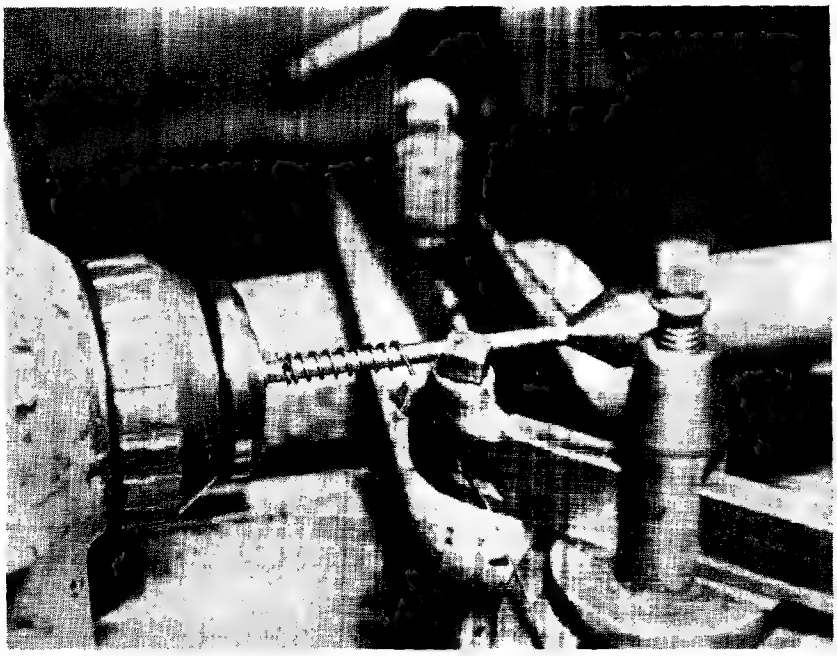

Fig. 23. Winding Firing Pin Spring on Mandrel

VII. FABRICATING WOODEN BOX

The wooden box portion of the box mine has three purposes:

(1) to serve as a container for the TNT or other explosives,

(2) to hold the firing device in place and

(3) to provide a means of regulating the weight or crushing pressure which will explode the mine.

It is preferable to make the box of soft wood such as white pine.

The box is easy to make and the only dimensions that are critical are the depth of the slots in the box lid and the drilling and positioning of the part containing the recess for the firing device.

Preparation of Lumber

The box is constructed of lumber planed to two thicknesses, one cm. and two cm., and in widths from 7.5 cm to 16.5 cm. Most of the box is made up of the thinner 1 cm. lumber. Drawings numbered 9 and 10 indicate the dimensions and quantities of each of the pieces required. Time can be saved if the lumber is planed and cut to size for a number of boxes before assembly (Fig. 24).

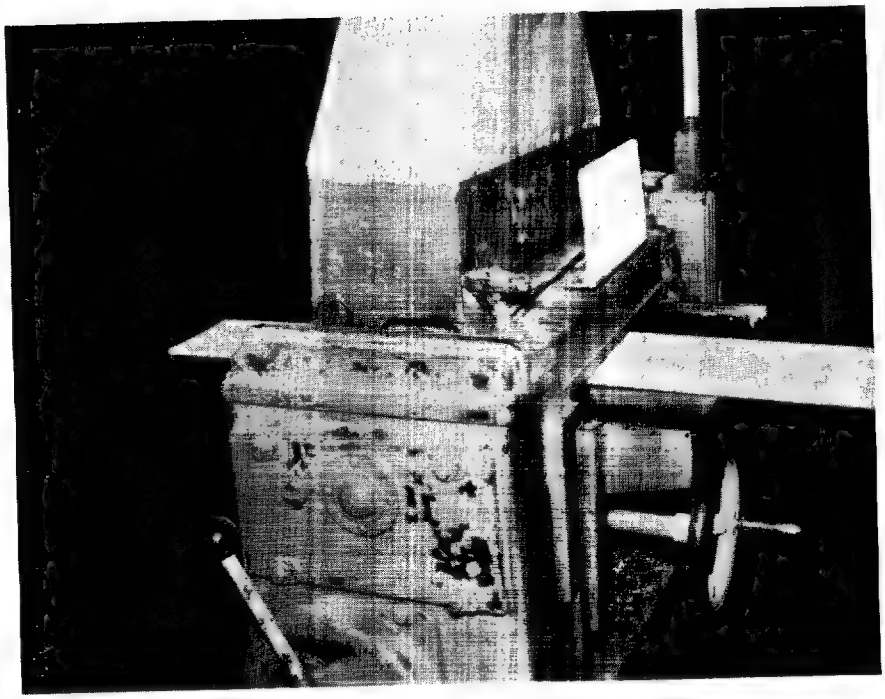

Fig. 24. Dressing Lumber to Desired Thickness

Cutting Grooves in Box Lid

Grooves are cut in the box lid (see Drawing No. 9) to control the crushing pressure necessary to actuate the firing device. The depth of the groove must be determined experimentally for different types of wood in order to obtain the desired crushing pressure. Softwood is more desirable because the crushing pressure required is usually lower. The grooves are cut with a bench saw (Fig. 25). The correct spacing of the grooves is obtained by proper adjustment of the saw fence. The depth of the groove is obtained by adjustment of the depth of cut. Note that the cross grain cut is deeper than that along the grain. The width of the cut is not critical and normal "set" in the saw will produce the desired results. The square "cut out" in the center of the lid is accomplished by cutting two "V" segments from each of the two pieces of the lid before they are nailed to the box, (see Drawing No. 10, Part No. 4).

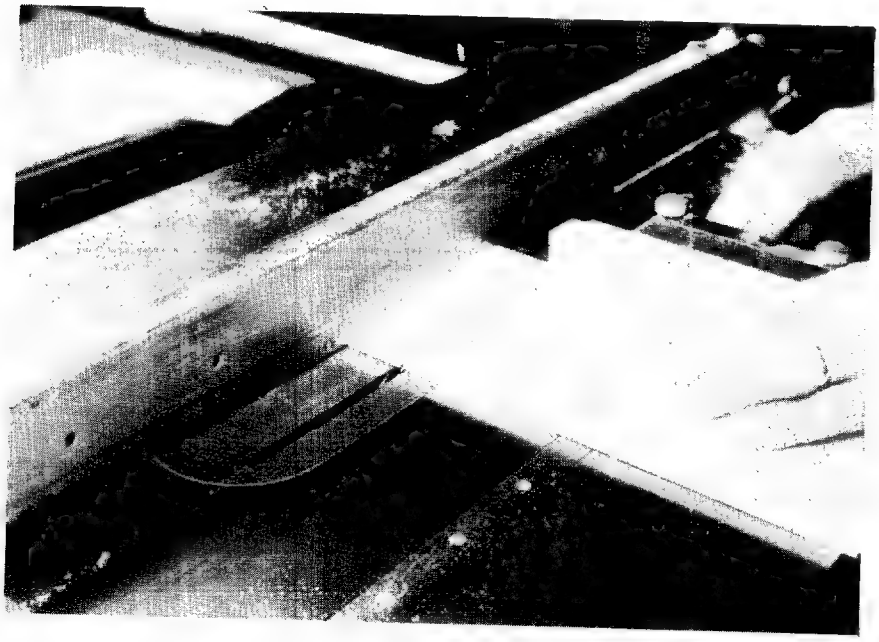

Fig. 25. Cutting Groove in Box Lid

Drilling Firing Device Recess

The firing device is held in position by a 2 cm thick wood support nailed inside the box. (See Drawing No. 10, Part 5). A recess is drilled in the center of the block to receive the firing device. By making a jig the hole can be rapidly located and drilled as shown in Fig. 26. Note that the jig has been clamped to the drill table and pieces to be drilled need only to be fed into the jig.

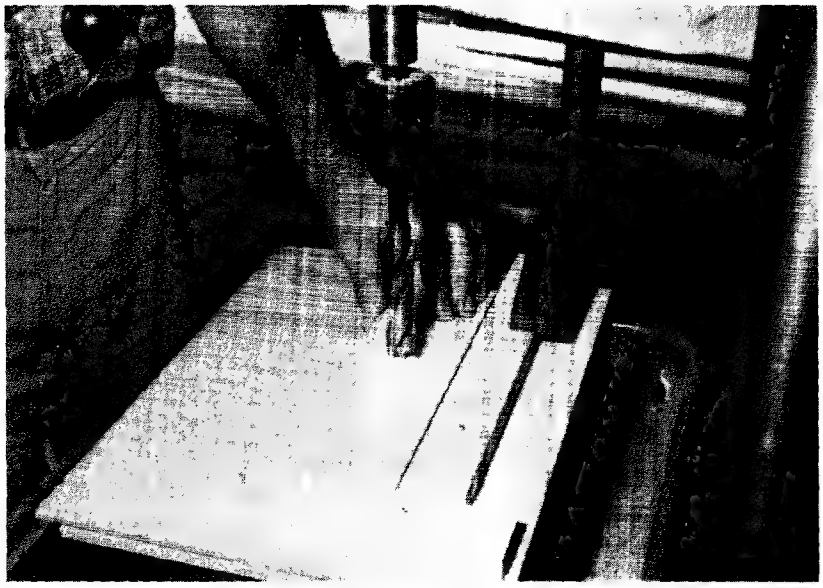

Fig. 26. Counter-Sinking Firing Device Recess

Assembly of the Box

The box is nailed together with small nails approximately 0.1 cm in diameter and 3 cm long. The firing device support must be nailed in place before the lid is nailed on. The nails in the lid should not be completely driven until the explosive is in place. The spacing of the support is critical (6.2 cm from the top and 8.4 cm from the bottom) and can be done quickly and easily by use of a gauge block as shown in Drawing No. 11. See Fig. 27 for method in which gauge block is used.

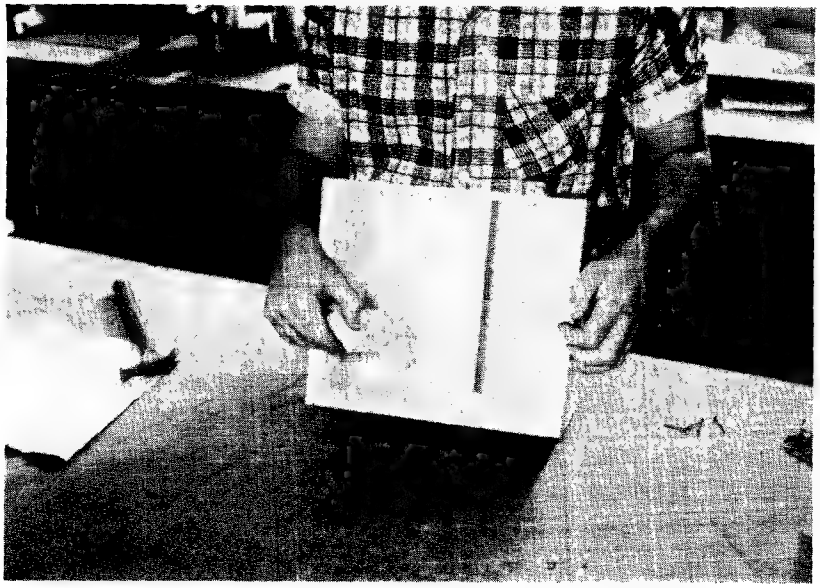

Fig. 27. Using Wooden Gauge to Position Center Partition

Assembly of Pressure Plate

The pressure plate, Drawing No. 10, Part 8, is assembled by nailing the parts together as shown. The positioning of the 6.5 cm block in the center of the pressure plate controls the positioning and orientation of the pressure plate relative to the grooves in the box lid. The block can be accurately and rapidly positioned by use of a template (Fig. 28). When placed on the box lid with the block in the cut out section of the lid, the pressure plate will cause the lid to break at the prepared slots when sufficient pressure is applied, and cause the firing device to function.

Fig. 28. Nailing Small Wooden Block on Pressure Plate

Loading the Box Mine with Explosives

The mine is shown in Fig. 29 and 30 filled to maximum capacity using uncut 1/2 and 1 pound blocks of TNT. Both figures show sequence and arrangement by layers. In each case one TNT block with a cap well must be positioned beneath the firing device recess. A blasting cap well is provided in each TNT block. The blasting cap is crimped onto the firing device and passed through the wooden partition and then into the TNT cap well while positioning the device in the mine. Whether using the 1/2 or 1 pound blocks, trim down to the proper size so that they may pass beneath the wooden partition in the mine. To insure detonation of the mine, the blasting cap should be entirely surrounded with explosive in this manner.

Loading Box Mine with 1/2 lb TNT Blocks

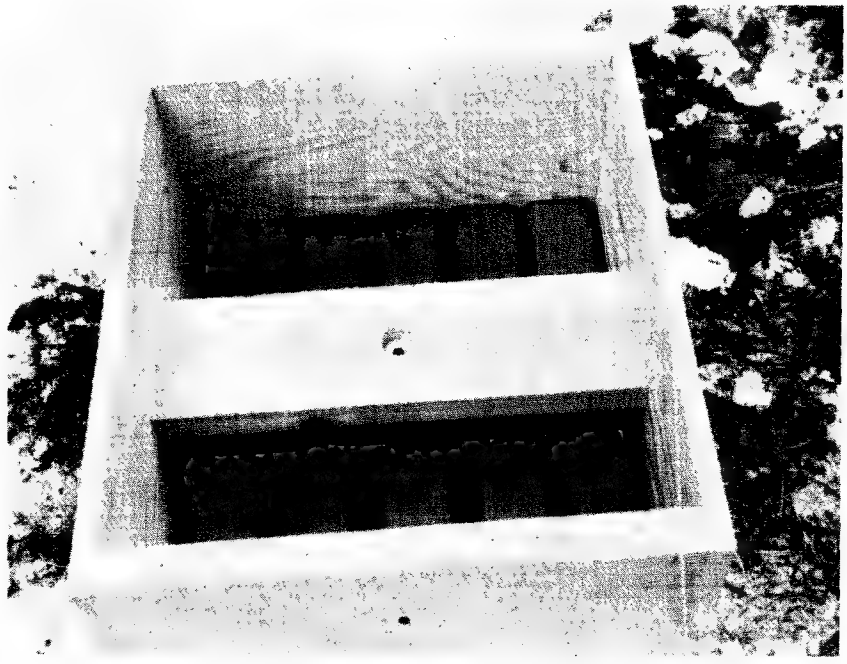

Fig. 29A. First Layer

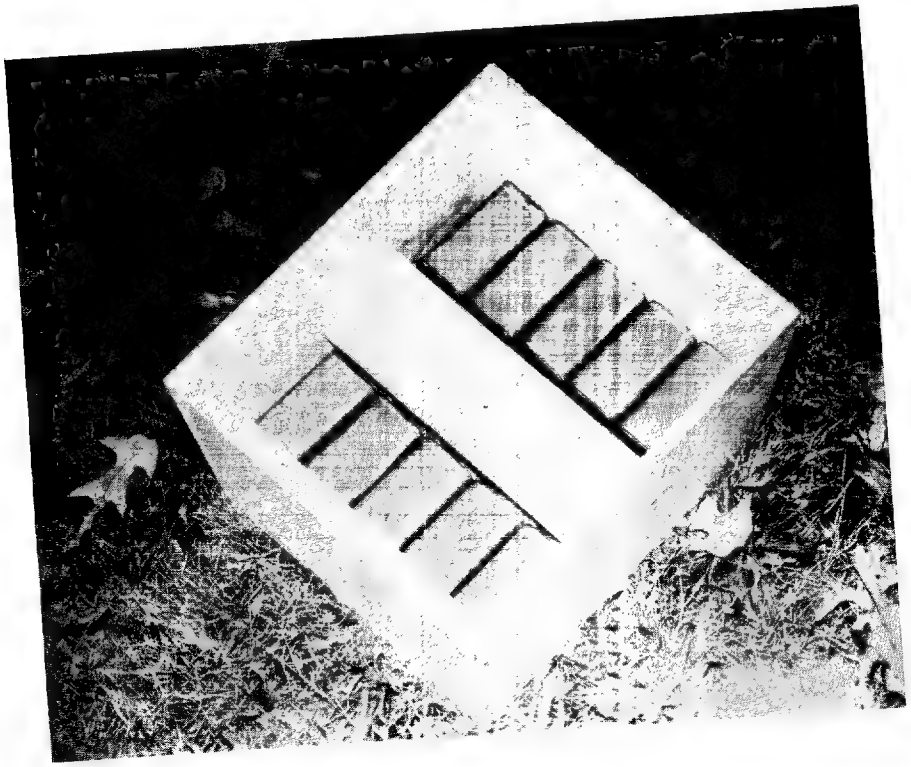

Fig. 29B. Second Layer

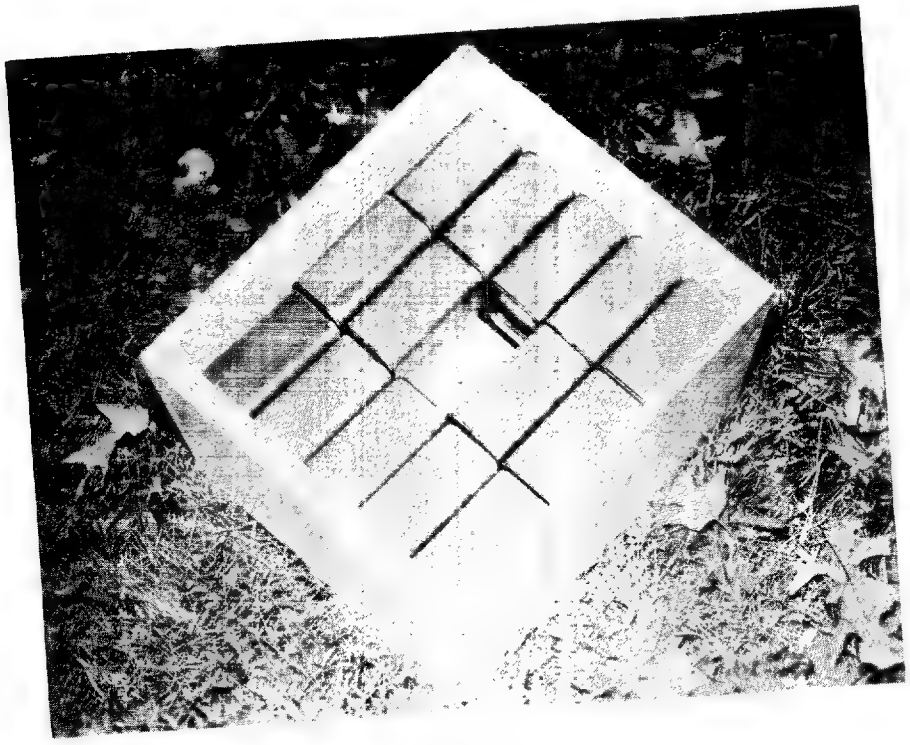

Fig. 29C. Third Layer

Loading Box Mine with Combinations of 1/2 & 1 lb TNT Blocks

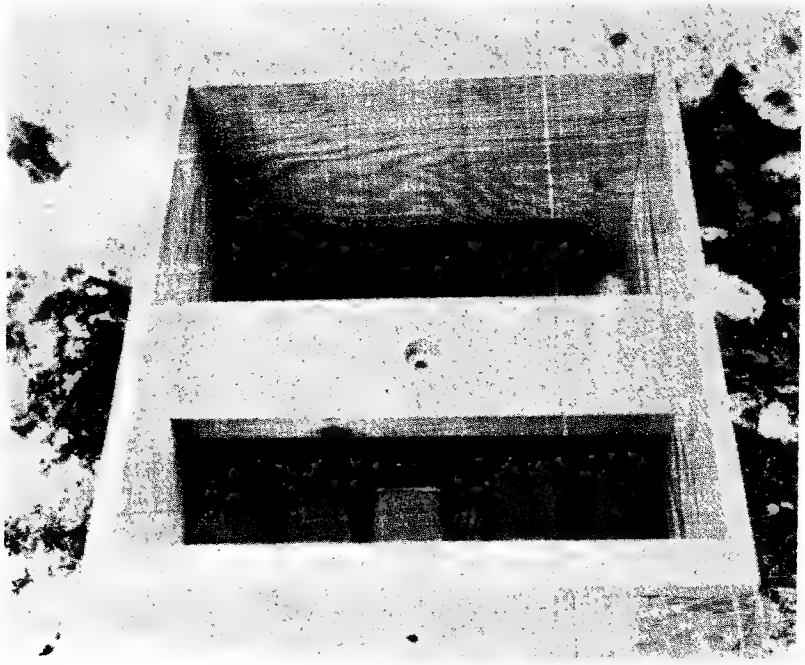

Fig. 30 A. First Layer

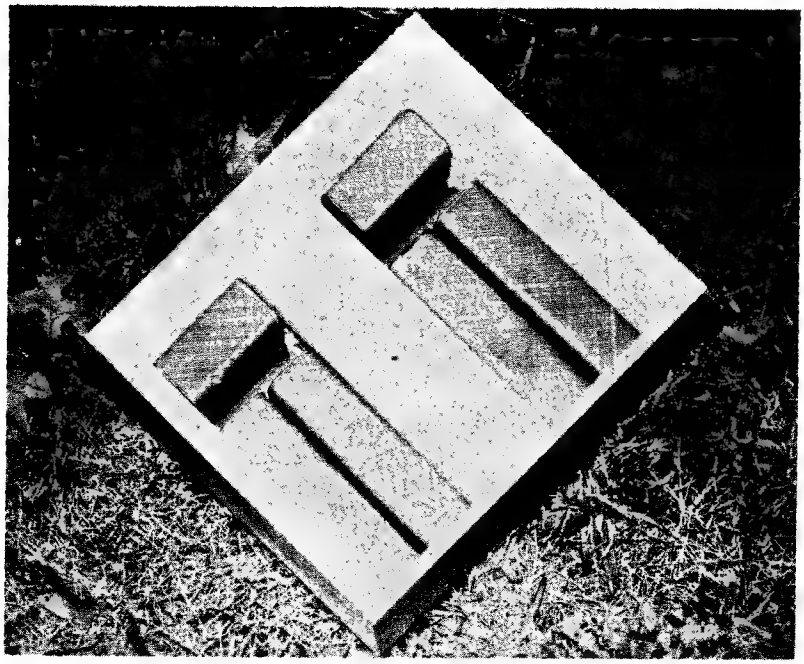

Fig. 30 B. Second Layer

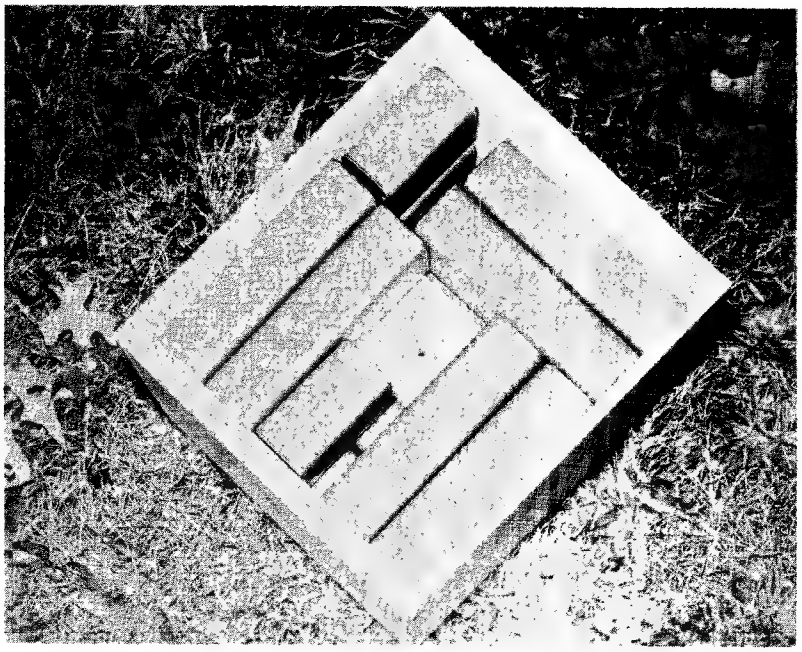

Fig. 30 C. Third Layer

VIII. ASSEMBLING FIRING DEVICE

Cutting Cartridge with Tubing Cutter

The cartridges from most rifle and pistol ammunition can be readily cut by a tubing cutter. If a hacksaw is used, be sure to file off rough edges on the cartridge primer before inserting into the firing device (Fig. 31). Removing the rough edges will help provide for a better fit into the device.

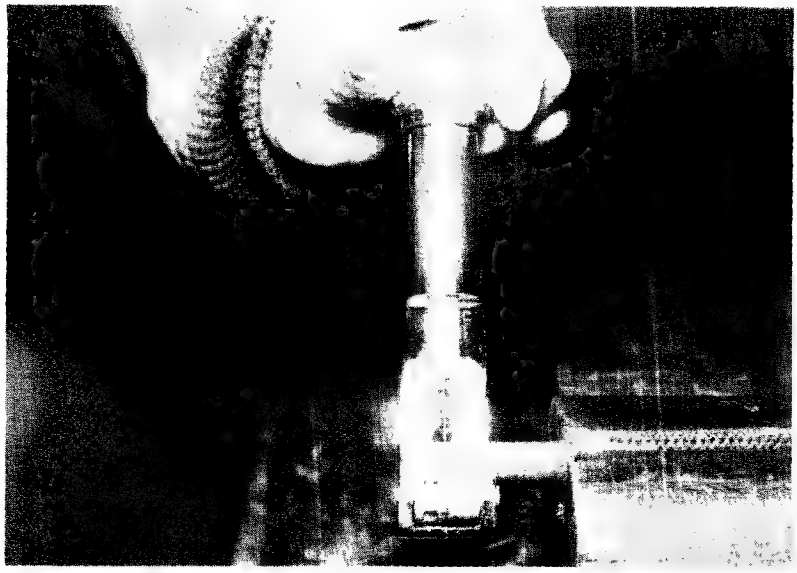

Fig. 31. Cutting Cartridge with Tubing Cutter

Sealing Cartridge Primer Aperture

Cartridge primer aperture should be covered with a small piece of masking tape to prevent moisture from coming into contact with the initiating charge (Fig. 32).

Fig. 32. Cut Cartridge Primers

Components of Loaded Firing Device

Figure 23 shows the various components of the loaded firing device.

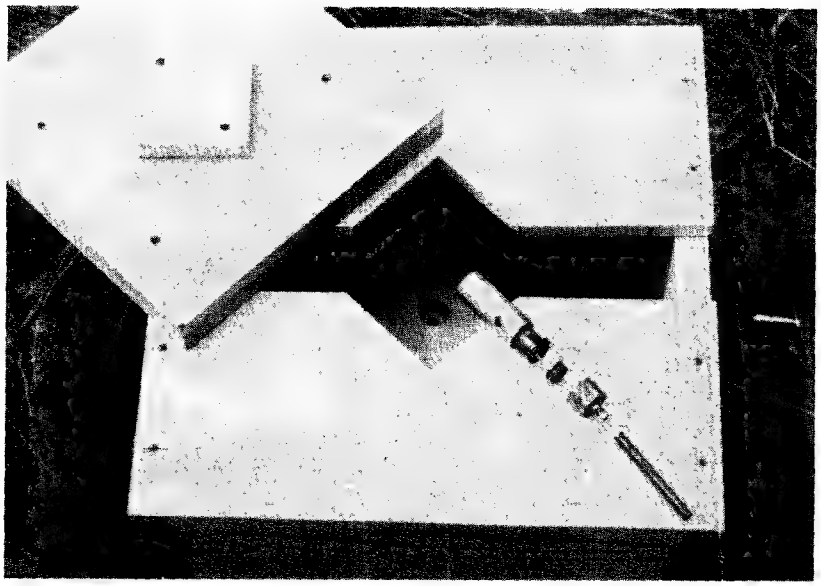

Fig. 33. Components of Firing Device

Placing Cartridge Primer Into Cap Section

Place the cartridge primer into the firing device and then seal the space around the cartridge with a waterproofing compound (Fig. 34).

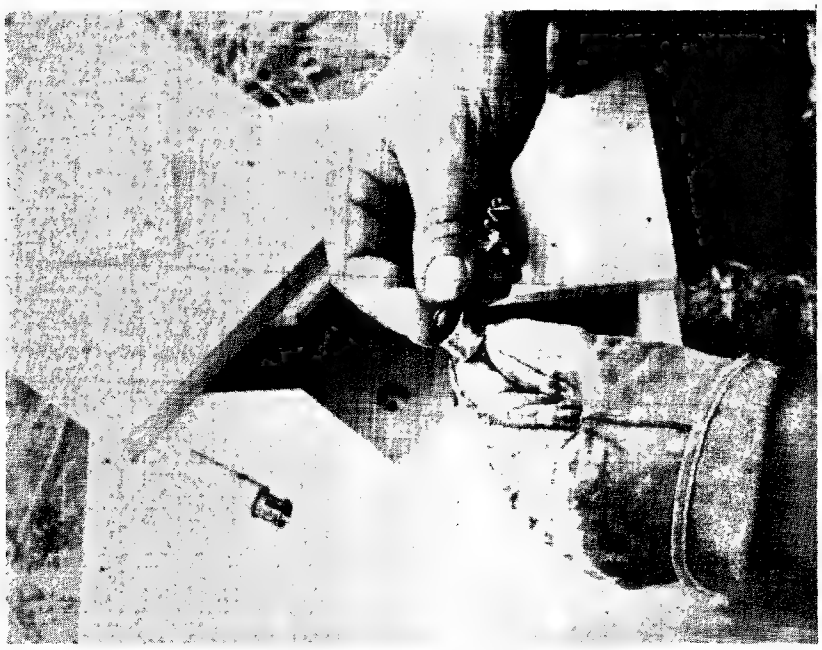

Fig. 34. Placing Cartridge Primer into Cap Section

Crimping on Blasting Cap

When crimping the blasting cap onto the cap section, place them both between the thumb and index finger as in Fig. 35. Slight pressure applied by the index finger will allow a snug fit against the cap section. After crimping, cover the joint with waterproofing compound.

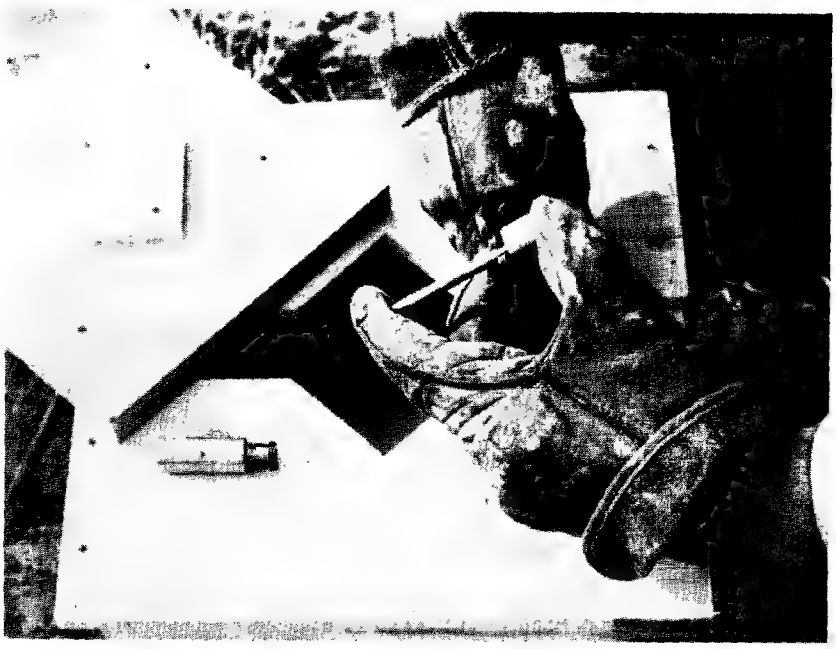

Fig. 35. Crimping on Blasting Cap

Assembling Firing Device

Caution: When screwing the cap section onto the body section, be careful not to apply undue pressure along the longitudinal axis of the firing device. Sufficient pressure may cause the device to discharge (Fig. 36).

Fig. 36. Assembling Firing Device

Placing Firing Device into Box Mine

Caution: Do not force the device into the firing device recess as undue pressure may be sufficient to function the device thereby setting off the mine (Fig. 37).

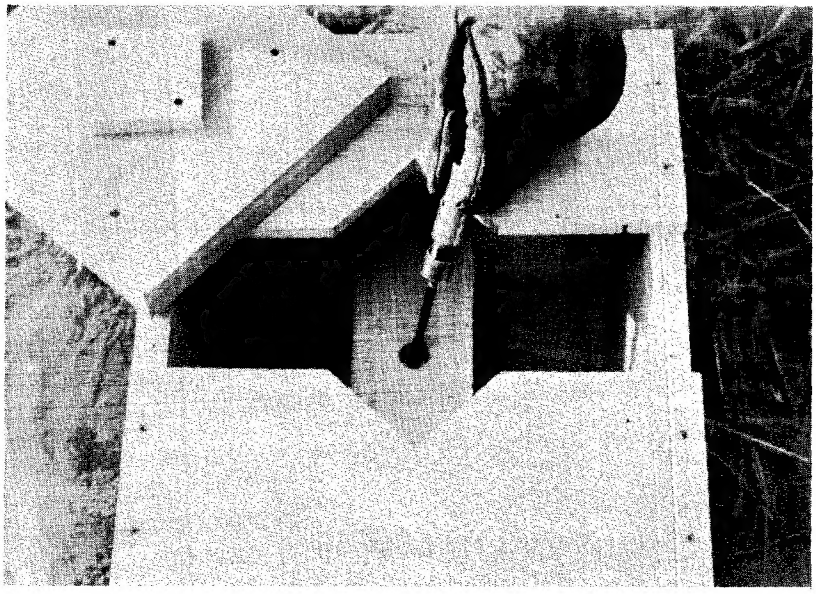

Fig. 37. Placing Firing Device into Box Mine

Checking Firing Device Clearance

This clearance should be between 3 mm to 6 mm. The clearance can be checked by simply placing a lid section over the top of the mine box before it is fastened on (Fig. 38).

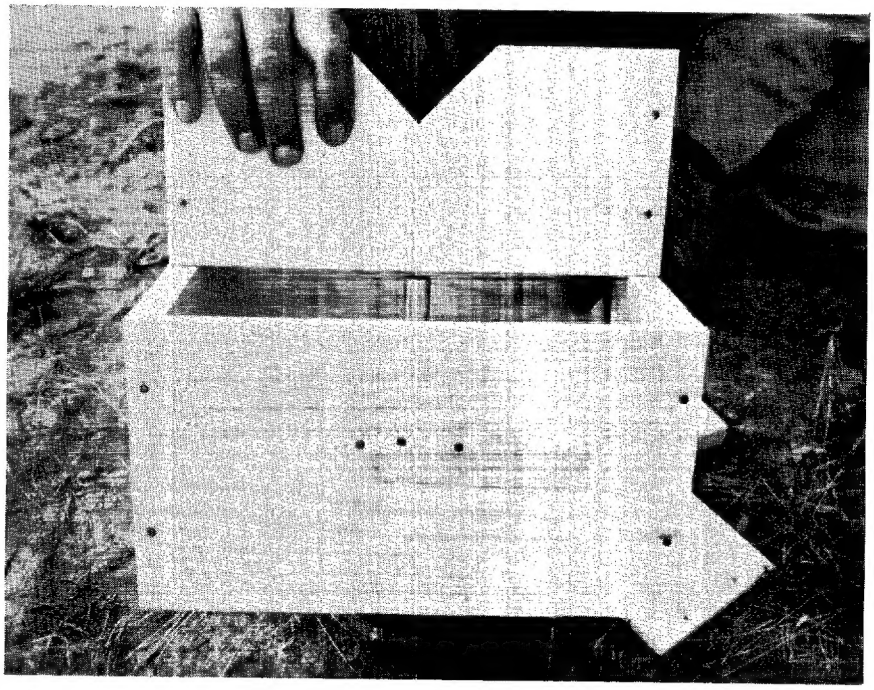

Fig. 38. Checking Firing Device Clearance

Positioning Pressure Plate

Place the pressure plate into position over the box mine after the lid sections have been nailed down. A quick check should be made to insure that the pressure plate is not touching the firing device.

If there is a gap between the plate and box lid, then the plate is resting on the device. This condition is dangerous. It must be corrected because it makes the mine unduly sensitive so that it may be accidentally detonated while being covered with soil.

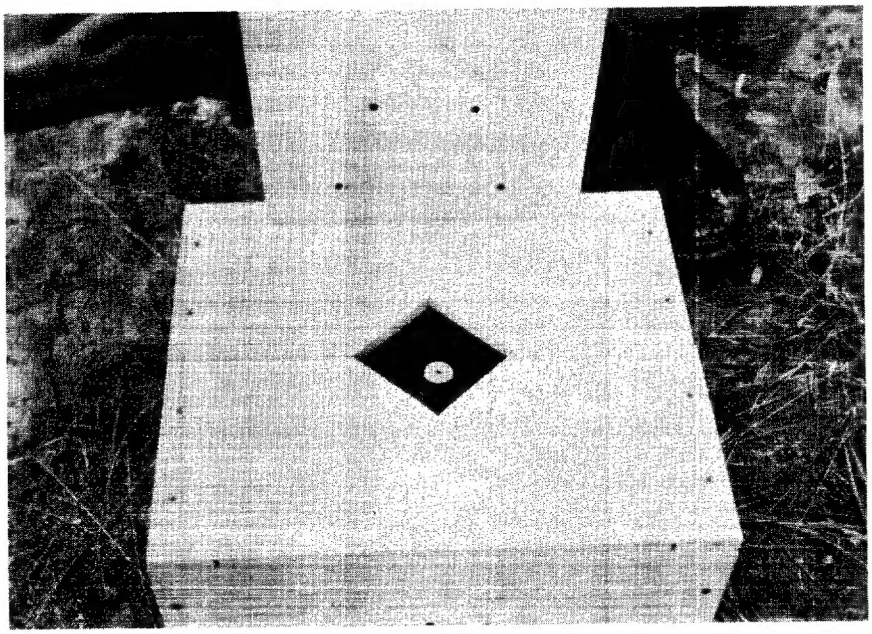

Fig. 39. Positioning Pressure Plate

Checking Ground Level Distance Above Pressure Plate

To measure depth of the mine below ground level, clear the loose dirt from around the hole (Fig. 40). Then lay a straight board (or something straight to measure from) across the top of the hole and measure the distance between the top of the pressure plate to the board.

Note: The pressure plate must be on the box mine to obtain this depth measurement.

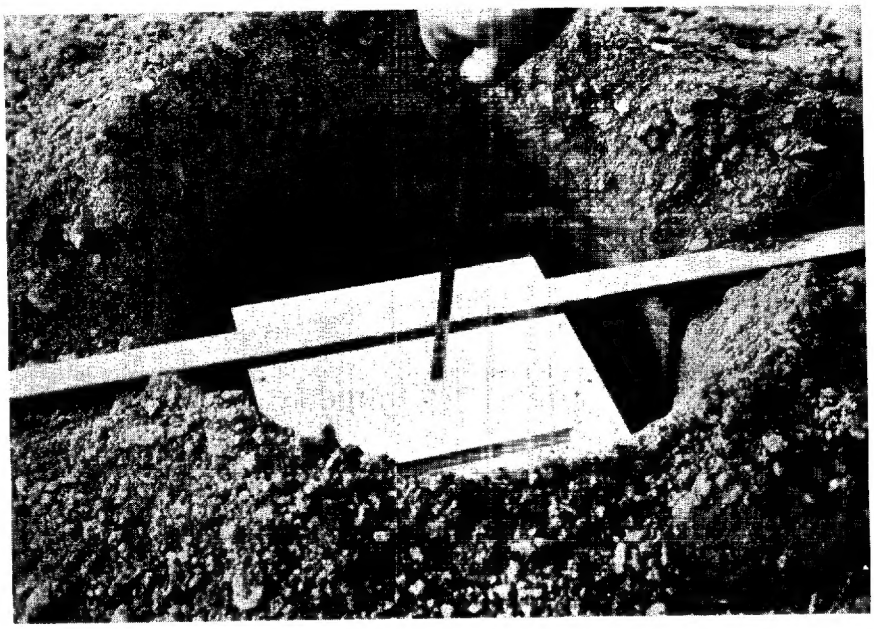

Fig. 40. Checking Ground Level Distance Above Pressure Plate